



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE AMERICAN JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. XVIII.

JULY, 1907.

No. 3.

THE PSYCHOLOGY OF CHESS AND OF LEARNING TO PLAY IT.

By ALFRED A. CLEVELAND.

OUTLINE.

| | PAGE |
|--|------|
| Introduction. | |
| I. The Psychology of the Game | 270 |
| 1. Chess as a form of human play | 270 |
| Varieties of the game | 270 |
| Instinctive factors | 271 |
| 2. General Features of Chess from a psychological point of view | 273 |
| The emotional effects of play | 273 |
| Personal and temperamental differences of players . . . | 274 |
| 3. Attainments of players of average ability | 274 |
| Ability to plan moves ahead | 274 |
| Visual imagination | 275 |
| Ability to take in large sections of the board | 276 |
| Reconstruction of the status of an unfinished game . . . | 276 |
| "Position sense" | 277 |
| Different grades of chess players | 278 |
| 4. Attainments of the chess masters | 278 |
| Simultaneous play | 279 |
| Recapitulation of games and other feats of memory . . . | 279 |
| Announcement of mate in advance | 281 |
| Blindfold play | 281 |
| The relation of skill in play to general mental ability . | 287 |
| 5. Special psychology of the game | 287 |
| Forms of mental activity required | 187 |
| The stages of the game and their logical types | 288 |
| The opening and end games | 288 |
| The middle game | 289 |
| Psychological restatement of the logical types | 291 |
| II. The Psychology of the Learning of the Game | 292 |
| 1. General description of the learning process in chess . . | 292 |
| 2. Discussion of the learning process | 297 |
| 3. Aids to learning | 303 |
| III. General summary of psychological points | 305 |
| Appendix: On the Case of a Feeble-minded Chess Player | 306 |

In this study an attempt is made to sketch the psychology of the game of chess, to trace the stages in the development of a chess player, and to interpret this progress in psychological terms. That the task, owing to the complexity of the processes involved and the impossibility of applying anything like satisfactory objective tests, is a difficult one, is obvious, but it is one that seems to the writer worth attempting.¹

I. THE PSYCHOLOGY OF THE GAME.

Chess is, as every one knows, a mimic battle fought upon a field of sixty-four squares with pieces moved according to an elaborate system and having powers suggestive of a variety of fighting units. The purpose of each player is to checkmate his opponent, that is, to hem in and threaten the latter's king in such a fashion that he is subject to capture at the next move. In our discussion of the psychology of the game it will be convenient to consider it first as a form of human play and then to take up more particularly the mental powers involved.

1. *Chess as a Form of Human Play.*

Forms and Varieties of the Game. The game of chess has not been confined to any particular age, race, country, or class. It is without doubt one of the oldest, if not the oldest, of the intellectual pastimes, and it is the game of skill *par excellence*. Its origin is not definitely known and there have been many claimants for the honor of its invention.²

Especially in its later history the game has developed a number of off-shoots in specialties which for many people share the interest of play across the board. The chief of these is the composition and solving of chess problems, which now has quite a literature and many devotees. Another is correspondence play, in which the strict rules of the typical game are somewhat relaxed on account of the peculiar conditions of play. Others, practiced as feats, but of especial psychological interest, are blindfold playing, to which Binet has devoted a special research,³ and the playing of many games at once (either blindfolded or with sight of the board). To some of these special forms we shall return later.

It is a pleasure to acknowledge my indebtedness to Professor E. C. Sanford for the suggestion of this topic of study, and for generous assistance in following it out; to Dr. C. A. Drew and others at the Massachusetts State Farm for courtesies extended; to those who in the capacity of assistants have contributed much to this study; and to all who have answered my questionnaire on chess or assisted in securing answers to it.

²The history of chess may be followed in Forbes's History of Chess, and in Dr. Van der Linde's book on its history and literature.

³Binet, Alfred: *Psychologie des grands Calculateurs et Joueurs d'Echecs*, Deuxième Partie, Paris, 1894.

Instinctive Factors in Chess Playing. Chess is, as we have said, a game of wide distribution and popularity. Dr. Emanuel Lasker states that over one million English speaking people know the game, that there are in the United States, England and Canada between seven and eight hundred good sized chess clubs, many of which have over one hundred members each, and that the City of London Club has over four hundred members;¹ and judging from the number of chess clubs, chess periodicals and players of high rank in Germany, France, Russia, Austria, and Poland chess is no less popular in those countries. If one were asked what class or classes of people play chess one might truthfully reply that all classes play it.

The question then arises: Why has chess proved so widely popular at all times and in all places? How has it been possible for a game making severe intellectual demands to hold a place historically and in geographical distribution beside such universal forms of human play as gambling, horse-racing, athletics, and hunting, and to claim devotees, if less numerous, at any rate as loyal as any of these? The answer is, of course, that, in common with a multitude of other games and sports, it appeals to the fundamental instinct of combat, in a way that is direct and at the same time exempt from the anti-social features that are inherent in actual physical combat. Here lies a large share of its attractiveness, and its capacity for stirring emotion. It takes hold upon those suppressed survivals of savage impulse (if we are to credit the savage alone with a first hand liking for a contest) which in their modified exercise have been shown to be so large a factor in adult sport.²

In this, however, it shows but the typical qualities of the genus to which it belongs—that it is one of the strongly competitive games.³ Its own specific attractiveness lies in the fact that it is a competitive game of *skill*, more particularly of intellectual skill as opposed to merely manual or bodily dexterity; it is a contest of scheme against scheme; it is a game of generalship.⁴ Each particular situation appeals to the player, not only as an occasion for attack or defense, but also as a situation to be met by taking thought, a difficulty to be seen through and overcome, a problem to be solved. There is, therefore, in chess playing all the challenge that lies in baffling but fascinating problems and much of that which lies in the solution of puzzles. That the interest in this aspect of chess is real and important is abundantly evidenced by the growth of the chess

¹ Lasker's *Chess Magazine*, Vol. I, No. 1, Nov. 1904. p. 48.

² Patrick: The Psychology of Football. *Am. Jour. Psy.*, Vol. XIV, 1903, pp. 368-381.

³ Groos: *The Play of Man*, New York, 1901. pp. 173 ff.

⁴ Groos: *op. cit.*, p. 190.

"problem," of which we shall have more to say presently. Lindley in his "Study of Puzzles"¹ holds it likely that in the puzzle solving passion we have a form of the preparatory play impulse to which Groos rightly attributes so much of both animal and human play.²

Still another factor of interest in chess is the pleasure of invention and origination, the pleasure of being a cause.³ In the returns of my correspondents a decided preference is expressed for original plans of attack and defense.⁴ Most say that they get away from the standard book plays as soon as possible after the first few moves. Some say that they play from book not from choice, but from necessity; but most say that while they follow the book openings for a few moves, they prefer to get away from them as soon as they possibly can without detriment to their game. They prefer their own game because it is more real, and is a better representative of their own ideas. As one player puts it, "There is little satisfaction in catching your opponent on a line of play that you have simply memorized." There are, also, of course, various practical reasons for this preference. An original plan throws both players on their merits and removes the game at once, so far as possible, from a mere memory exercise, thus depriving a player of the advantage which a superior memory or a better knowledge of book games might give. There is an advantage to the player himself in an original plan in that his game is more likely to be a unit and consequently more consistently played than one partly remembered and partly originated. While the inability to remember particular lines of play is undoubtedly a determining factor in the choice between an original plan and what is known as book play, nevertheless, there is something attractive about a game which one feels to be his own, especially if it is successful.

In summary we may say of chess as a form of human play that in the first place it is a contest, and, as such, it appeals to the fundamental fighting instinct, the instinct which in every normal individual impels him to measure his skill with that of

¹ Lindley : A Study of Puzzles, *Am. Jour. Psy.*, VIII, 1897, pp. 431-493, especially p. 437.

² Groos : *op. cit.*, pp. 369 ff.

³ Groos : *op. cit.*, p. 385.

⁴ In order to supplement my own observations and those of my assistants, a questionnaire was submitted to chess players of different grades of ability. The list of players answering is a fairly representative one and contains the names of some of the best amateurs of the United States and Canada. Some of the data from this source are specifically included in this study, but in many other cases the substance of the views expressed has been incorporated without more acknowledgment than is here made. About 100 answers in all were obtained.

others. In the second place chess offers its devotees opportunity to exercise their ingenuity in the solution of problems and puzzles, a form of pleasure that may well rest upon that general interest in the unknown which at one time must have had the greatest survival value. It would seem further, that intellectual activity is indulged in for the pleasure which such activity gives in itself, and sport of this kind is, perhaps, an expression of the general play instinct. "Intelligence," as Lindley holds, "is no exception to the law of exercise. Just as those animals, which by fortunate variation were born with a tendency to indulge in preliminary exercise of those activities which were to serve the serious ends of adult life, were favored by natural selection, and were able to transmit such advantages in the form of general play instincts, so in a more special way those creatures, endowed with the strongest tendencies to exploit the intelligence, may have perpetuated this superiority as a general intellectual play instinct."¹ Again, the chess strategy of an individual is largely the product of his own brain; it is his own, and merely as such is interesting to him. No matter where or how he got his knowledge of the game, if he is anything of a player, he has assimilated it and made it a part of his mental self, and his game, in turn, reflects something of his personality. There is also what might be termed a secondary, derived or æsthetic interest in chess, namely, in the finer and subtler points of the game, in what the chess world calls its "brilliancies." Appreciation of and consequent admiration for the skill of others is a contributory element in this pleasure. And finally it is, notwithstanding its own exacting demands, a means of mental relaxation and as such is attractive to the mental worker.

2. GENERAL FEATURES OF CHESS FROM A PSYCHOLOGICAL POINT OF VIEW.

The Emotional Effects of Play. We have already alluded incidentally to the emotions which may be stirred by the chess combat. The desire to win is fundamentally connected with the fighting instinct.² Young and ardent players especially find the elation of victory and the bitterness of defeat by no means small; they work hard at the game and feel the outcome in proportion to their efforts. The chess manuals and maga-

¹Lindley: *op. cit.*, p. 437.

²This instinct in man, we are told, is being gradually overcome or suppressed. It would be interesting to note, however, whether in the contests which still give opportunity for it, there is any lessening of the desire to win, and whether individuals change at all in this regard. The fact probably is that the instinct is changing its form with social pressure, but losing little of its native power.

zines repeat suggestions as to how one should wear his laurels or accept defeat, but in spite of this well intended advice every chess club has its members who invariably make excuses for every lost game. A good many players, however, have the sportsman's feeling strongly developed and are not unpleasantly affected if they are conscious of having played well. They do not enjoy winning if their victory is the result of a "fluke" on their own part or of a palpable oversight on the part of their opponent.

Personal and Temperamental Differences of Players. The opinion is general among chess players that a man's temperament enters into his play and determines its style. Many of my correspondents state that they have recognized and often utilized this factor in actual play by forcing an opponent to adopt a line of play for which he was unfitted by temperament. For example, a slow, careful game is played against the aggressive and daring player, who is often provoked by these Fabian tactics into recklessness and loss.

Chess players are also very firm in the belief that one's game is an index of his character in a wider sense, and no one will be likely to deny that the fundamental traits of character are revealed in unimportant matters especially when one becomes so deeply absorbed that he forgets all else. Chess offers just such an opportunity for deep absorption, and it is not unreasonable to suppose that one's real rather than his conventional character will reveal itself.

3. ATTAINMENTS OF PLAYERS OF AVERAGE EXPERIENCE.

In order to form some conception of the skill and knowledge which a chess player of average experience possesses, let us consider (a) his ability to plan moves ahead and to anticipate those of his opponent; (b) to disentangle a complicated situation; (c) to reconstruct the status of an unfinished game from memory; and lastly, (d) his "position sense." For information on these points I shall, of course, have to depend almost wholly on the replies of my correspondents.

Ability to Plan Moves Ahead. It is evident from the variety of answers to the questions on these points and the qualifications attached to many of them that the questions were interpreted in a variety of ways. Some points seem clear, however. The number varies from position to position, is dependent upon the number and positions of the pieces and the player's physical and mental condition at the time. Very few stated any definite number of moves which they thought they usually planned ahead, but allowed a considerable margin. The following are typical of the answers received:—"five to ten," "two to six," "two to ten," "six to ten," "three to seven."

Very few state that they are unable to plan at least three moves ahead in a complicated situation. Four, five, and six are favorite numbers.

Most state that they can anticipate as many of their opponent's moves as they plan for themselves, and that they do so habitually. A few state, on the other hand, that they can anticipate only a much smaller number of their opponent's moves.

Almost without exception my correspondents write that practice has greatly increased both numbers, but especially the number of the opponent's moves that can be foreseen. A few who have played a great many years or who seldom play now, say that the number has decreased. While with most players the increase in number has been considerable, the increase in accuracy has been the main gain. The beginner, owing to the great number of possibilities, is not able to plan far ahead and scarcely thinks of his opponent's plans at all. A little later he plans two, three, and four moves, but he overlooks so many possibilities that his plans are practically worthless. Progress in this regard consists first in the increasing ability to perceive the most likely and feasible continuations both on his own part and that of his opponent; second, in refusing to reconsider lines of play after going over them carefully once and discarding them; and third in increased ease, rapidity and accuracy in calculation.

Visual Imagination. It was asked "Can you imagine, pictorially, what difference in the position a move would make, or are you absolutely without such an image, relying wholly on successive associations of one move with another?" The answers seem to indicate that there are three classes of players in this regard. There are, first, those who have a clear visual picture of the situation as it will appear after a series of moves; secondly, those who have some visual picture, but rely also on successive associations, in verbal or possibly motor terms, of one move with another, that is, they are unable to picture a resulting situation, but must build it up move by move by means of visual and other kinds of imagery. With these players the final term is probably held in verbal terms. The last class of players are those who are without a visual image of any sort. The first class is perhaps the smallest. The players in this group state that the presence of the pieces is not only not an aid in planning combinations, but that it is a positive hindrance. They have difficulty in imagining a piece in a changed situation or on a square which is at that time occupied by another piece when the pieces are on the board before them.¹

¹ Binet: *op. cit.*, p. 236.

Binet quotes Selkirk approvingly as saying that in working out a plan one is obliged to represent to himself the position of the pieces after each supposed move and that the sight of the board only confuses. Dr. Tarrasch, the German master, holds that all games are played in part without sight of the board and that consequently visual imagery is an essential factor in planning moves ahead, especially in far reaching combinations.¹ This statement, it seems to the writer, is valid only for players of the first class mentioned above. The players of the second group have some picture but find the presence of the pieces indispensable; while those of the third group rely wholly on the presence of the pieces. In some cases this dependence on the pieces is largely a matter of habit, since the players state that while they rely almost exclusively on successive associations, nevertheless, they can often discover errors in their games when the board is not before them.

Ability to take in Large Sections of the Board. Most of the players state that when getting ready to move they can readily take in the whole disposition of their men, or, in other words, they can comprehend the board as a whole. This ability to take in readily the whole disposition of the men is generally regarded as one of the signs of a considerable degree of chess skill. Ability in this regard varies with the physical and mental condition of the player and with the complexity of the situation. The explanation of the gain in skill of this sort seems to be that, as a player progresses in skill, the game takes on more and more meaning and that the individual moves become more and more a part of a definite series or of a number of series each with some particular end in view. The different moves and situations, also, as they are handled in larger masses, are dealt with in an increasingly symbolic manner. A more detailed consideration of this will be taken up in another section.

Reconstruction of the Status of an Unfinished Game. Little or no trouble is experienced by most players in setting up an unfinished game from memory, provided the game itself was interesting and too great a time had not elapsed. The number of pieces on the board is also a factor, though it would appear that it is not of very great importance. A very few state that they can do this only when they are playing regularly. One player reports that he retains a position in correspondence play for a month without difficulty, and another that he is engaged at present in eleven correspondence games and that he retains the positions in all of them without reference to his record.

Different methods are employed in the reconstruction, but all

¹ Binet: *ibid.*

are reducible to two types, namely, setting up the final position, and replaying the game from the start. Some are able to do either. There are different varieties of the first method. Some seem to have a mental picture of the whole board and to arrange their pieces accordingly. They have photographed the situation as a whole and the eye tells them if anything is out of order or missing. Analogous to this in a small way is the ability to see a misspelled word in proof-reading. Others also reconstruct the final position as a whole, but do it by remembering crucial situations and building around them. This memory may be in terms of almost any sort of imagery, but it is most likely to be in visual terms. Verbal imagery also plays an important part. The plan of attack or a certain situation in that attack, is very often the central point from which the position is built up. This would mean that the steps which had been planned ahead were also factors in the recall. Sometimes it is necessary to begin back of the final position at some important place and to build up to it. The second method, that of replaying the game from the beginning, means the running over of a series of successive associations aided and guided by the critical points and by the general plan of the whole game which gives a meaning to the individual moves. The reconstruction from memory of a position involving any considerable number of pieces is not possible to most beginners. If they are of the photographic mental type they get lost in the mass of impressions which the situation involves, and if of the verbal or some other type the situation has not sufficient meaning to give definite place and order to so many pieces.

"Position Sense." Among chess players and writers on chess great stress is laid on what is called "position sense," that is, the knack of knowing in an intricate situation how to place the men to the best advantage. It is a common observation that many chess players are able to tell at a glance which player has the better position without being able to give off-hand any reason for the opinion. It is even stated that many players are able to give a correct judgment at times without being able to carry out the analysis necessary to prove its correctness. Bird, the well known English player, used often, in consultation play, to point out the move with the remark that the others might analyze as much as they liked, but that he felt and knew that it was the right move, and it is said that he was generally right. With scarcely an exception all who answered the question stated that they have noted a considerable improvement in "position sense." Many state that improvement in the sense of position and chess improvement are one and the same thing. This latter statement is a little too sweeping, however, since it does not necessarily follow that the mere

knowledge of the strength or weakness of a position will enable one to choose the best of the infinite possibilities which arise at every step. Experience is the blanket term which most use in the attempt to explain the development of "position sense." The player is said to "feel" the position or the proper move. Some interesting reasons are given, however, to account for the ability to judge a position at a glance. In brief they are somewhat as follows: The mind has been drilled to feel any deviation from principles; it is due to a vague idea of similar situations leading to success or failure; it is the recognition of several fundamental points of strength or weakness; and lastly, it is a symbolic shortening, a dropping out of intermediate processes of inference. Perhaps we should not be wrong in saying that it is all of these. It is undoubtedly the product of experience and involves the same sorts of psychic processes that are employed in the formation of general ideas—abstraction and generalization. Players of equal experience differ so widely in "position sense" that it seems reasonable to suppose that there is a difference in their native endowment in this capacity, just as, according to Professor James, people are differently endowed with the capacity for memorizing. "Position sense" is, however, not dependent on memory alone.

Different Grades of Chess Players. Certain mental qualities are essential to the chess player who attains any degree of proficiency whatever, and players differ both in their relative and their absolute endowment of these qualities. Master players combine to a marked degree an accurate and persistent chess memory, quickness of perception, strong constructive imagination, power of accurate analysis and a far seeing power of combination. It is impossible to say just what the proper proportion of these qualities should be, and to be ideal it would have to be modified to meet each new opponent. When these various qualities are combined in something like the proper proportion we have what is generally designated as a separate quality, namely, "judgment." But when we say that a player has good judgment in chess do we mean more than that he combines in something like the proper proportions the qualities which make up the uniformly consistent and successful chess player?

4. ATTAINMENTS OF THE CHESS MASTERS.

We have attempted to give some idea of the endowment of the chess player of fair ability and have avoided all reference to the remarkable achievements of the chess masters. The feats of some of these are certainly marvellous, and one is apt to think that genius alone can account for them. The chess ex-

pert displays his skill under one or all of four forms, namely, Simultaneous Play, in which several games are played at the same time against as many opponents; Blindfold Play; Recapitulation of Games played by himself or others; and, in actual play, by the Announcement of the End of the Game several moves before that event.

Simultaneous Play. In simultaneous play the lone player, of course, never plays against those of his own rank, but usually against strong local players who are able to take advantage of any oversight. As examples of what can be done, the following, recorded in the different chess magazines, may be cited:—Gunsberg played eighteen games simultaneously against as many opponents, winning fourteen, losing three and drawing one; Bird played nineteen, winning fifteen, losing one and drawing one; Herr Schallop in four and one-half hours played forty simultaneous games, winning thirty-three, losing five, and drawing two; Lasker played twenty-two games, winning nineteen, losing two and drawing one. Since that time he has often played thirty games simultaneously. As an example of the rapidity of moves made in simultaneous play Napier's twenty-one games should be cited. During the first hour he made four hundred and fifty moves, an average of nearly eight per minute. Of the twenty-one games he won eighteen, lost two and drew one. Evidently simultaneous play requires the ability to focus the attention strongly on a single game, to banish for the time being every other game from the mind, to call up instantly at the sight of any board just what combinations it had been planned to carry out there, and finally to recognize and meet a situation promptly. In all such feats experience is an indispensable factor. The player who plays several games at the same time relies on his knowledge of position, gained through long practice, to give him a quick grasp of the essential situations as he passes from board to board.¹ This factor and the power of concentration seem to account for the distinctive features of simultaneous play.

Recapitulation of Games and Other Feats of Pure Memory. The recapitulation of games is a feat of memory pure and simple. The player simply plays over, or dictates from memory games which he himself or which others have played. The games thus enumerated may consist of fifty or even more moves on each side making sometimes a total of one hundred or more individual moves. Morphy, the next morning after his blindfold contest against eight other players at Paris, dictated to his secretary all of the moves in each of the eight games. Morphy's

¹ A player of perfect "position sense" could play any number of games *ad hoc* without recalling anything.

secretary, in his book entitled "Exploits and Triumphs in Europe of Paul Morphy," gives the following account of the performance:—"Next morning Morphy actually awakened me at seven o'clock and told me if I would get up he would dictate to me the moves of yesterday's games. I never saw him in better spirits nor less fatigued than on that occasion, as he showed me for two long hours the hundreds of variations depending upon the play of the previous day, with such rapidity that I found it hard work to follow the thread of his combinations."¹ In speaking of Morphy's knowledge of games played by Anderson, he writes: "With his astonishing memory he gave me battle after battle with different adversaries, variations and all."² And in another place, "What wonderment he has caused with his omnipotent memory. I have seen him sit for hours at the Divan or the Regents, playing over, not merely his own battles, but the contests of others, till the spectators could not believe their senses."³ Morphy himself made the statement that he had never forgotten a game that he had played after his chess powers were mature. Blackburne likewise has a tenacious memory for his past games. In 1899 he recalled any number of games which he had played in 1862, pointing out with the utmost precision the flaw or the beauty in each.⁴

In regard to the recapitulation of games it should be noted that the player is recalling a number of known situations each the result of a well known series of moves, and that each game as a whole is constituted of, and characterized by, a number of situations joined together by distinctive features which may consist either of individual moves or of combinations of them. The case is similar to that of a remembered conversation; the one who recalls it does not recall each word separately but rather the *meaning* of each remark and its connection with what preceded or followed.

Other Feats of Memory. Blackburne, without sight of the board, is able to give the moves known as the knight's tour, which consists in placing the knight on any designated square and making it strike in succession every square on the board. This is by no means an easy task with the board in sight, a fact of which any one may easily convince himself. Aside from chess Pillsbury performed some rather difficult memory feats. If any portion of a deck of playing cards was called off

¹ Edge, F. M.: *Exploits and Triumphs in Europe of Paul Morphy*, N. Y., 1859. p. 164.

² Edge: *op. cit.*, p. 187.

³ Edge: *op. cit.*, p. 187.

⁴ Graham, P. Anderson: *Mr. Blackburne's Games at Chess*. London, 1899. p. 207.

to him, he was able to name the cards remaining in the deck. On one occasion, after playing blindfold games for two and one half hours, during the intermission, a list of thirty words, numbered from one to thirty, was read to him. He memorized the words in groups of five taking ten minutes in which to complete the task. Then he was able to give the word corresponding to any given number or the number corresponding to any given word and to repeat the whole list either forward or backward.¹ He made use, of course, of some mnemonic device and the case is interesting only as showing what can be accomplished in that way.

Announcement of Mate in Advance. The announcement of mate several moves ahead means, in case it is not merely a remembered position, that the player has looked ahead of the actual play and is able to say the precise number of moves necessary to bring about the end of the game. It is a common thing for players of the first rank to announce mate five or six moves in advance and their combinations in the middle game often reach beyond that number. Blackburne, in one of his blindfold performances, after the twentieth move, announced mate in six moves more and then called off seven variations which exhausted the position.²

Marshall, in London, announced mate in eight moves and proceeded to accomplish it in spite of all his opponent could do to prevent it. The longest mate ever announced in blindfold play was one by Blackburne in sixteen moves.³

In some cases planning ahead, as was suggested above, is a simple act of memory. The player may merely recognize the situation as one previously seen and may remember the individual moves which followed and the result; or he may pass directly from the first term, the situation, to the last term, the result, recalling at the same time the number of moves, but not the moves themselves. Where the player has never reached mate from the given situation, but is able to foresee it, he must possess the ability to work through mentally all the situations which come between the one given and the final one, which calls for good powers of analysis and memory as well as experience.

Blindfold Play. The feats which have caused most wonder and admiration are those of blindfold players. Playing without sight of the board is now one of the most common forms of exhibition chess, and it has been said that almost every good amateur can play at least one game *sans voir*.

Paul Morphy, during his triumphal tour of Europe, created

¹ *British Chess Magazine*, Vol. XX, p. 399.

² Graham: *op. cit.*, p. 209.

³ Graham: *op. cit.*, p. 211.

great astonishment by playing eight simultaneous games blindfolded. It is said by competent judges that some of his most brilliant games were those played in this way. Zukertort played twelve and fourteen games very frequently, but often remarked that the two additional ones made it much more difficult. Blackburne is one of the strongest of the blindfold players, but the greatest of all thus far in this line was the American, Pillsbury, who played as many as twenty-two blindfold games simultaneously, winning most of them. With him the number of games seemed to be limited only by the length of time required to complete them and by his physical endurance.¹

Pillsbury, in an exhibition given at Toledo, Ohio, played twelve games of chess and four of checkers without sight of the boards, and at the same time played duplicate whist.

Such are the feats of blindfold play by the masters. What shall we say in explanation of them? Memory certainly plays a very important rôle, but it may be chiefly of the short time variety, that is, the player holds the moves in mind only during the progress of the play and forgets them immediately afterward, much as the student or the lawyer does the facts he has crammed for a particular occasion. Pillsbury, in an article, said that he had to think rather hard to recall the opening in any given game of a series five minutes after the contest ended.² Morphy, on the other hand, seemed to retain his games permanently.

A blindfold player, playing a single game, must have in mind at every stage of the game the position of every piece on the board, and he must have some way of knowing or of calculating the relation of each piece to every other, facts which are not necessarily involved in mere place memory. His knowledge of these positions and relations must be sufficiently clear to enable him to form combinations for attack and defense. In playing eight, ten, twelve, sixteen or twenty games simultaneously without sight of the boards, the task is, of course, immensely more difficult, since the player has not only to remember a proportionally greater number of moves (or positions) but has also to remember each move or set of moves in relation to the particular game in which it is made.

The blindfold player, playing several games simultaneously, usually employs devices to make his task less difficult. Pills-

¹ The physical endurance required for play in such contests is something little realized by the uninitiated. Morphy, at Paris, played for ten consecutive hours without eating or drinking anything. Paulsen, who played as many as ten games blindfold, played twelve consecutive hours on one occasion with no refreshments of any kind except a little lemonade.

² Pillsbury: *The Chess Player's Mind*. *Independent*, Vol. LII, p. 1104.

bury grouped his games and used the same opening in all games of a group. For instance, in playing sixteen games he grouped them as follows: group one contained boards 1, 5, 9, 13; group two, boards 2, 6, 10, 14; group three, boards 3, 7, 11, 15; and group four, boards 4, 8, 12, 16. It will be noticed that two groups contain odd and two even numbers, and that there is a difference of four between any number of a group and the one next to it—1, 5, 9, etc. The blindfold player usually has first move on all boards and can generally force his opponent into his system. If not, he may regroup the boards according as they do or do not fall into his system of play, or he may simply make a mental note of the boards on which eccentric replies to his opening moves have been made. Obviously, so long as the games in each group proceed without variation from the usual moves and replies, there is little chance for confusion, but very soon the game begins to vary. By the time this happens, however, the player has noted some distinctive feature by means of which to recall any game. Pillsbury put it in this way: "By the time twenty moves have been made there has been some clearing of the board and a definite objective has been developed. When I turn to the new board I say—Ah! number nine. This is the board on which we have exchanged queens; and the whole play comes back to me."¹

In other words, the variation itself, because it involves some distinctive feature, is the cue for the recall of all the moves that have preceded it and those which grew out of it. It will help us to understand this if we recall the fact that chess is, as Binet puts it, a contest between ideas, and that each move is but a part of a series all working together toward the same end, or in other words, each move is remembered because it is a necessary part of a plan.²

He points out further that those who retain in mind a situation or a series of moves have the faculty of giving to the situation or the series a precise significance. A person ignorant of chess could not, of course, do this and so would be unable to hold such things in memory. Mr. R. L. Newman also, experimenting upon checker players in the laboratory of the University of Indiana, found that a long series of moves in checkers, made in the presence of his subjects, was remembered only after some form of grouping was employed and that the series was learned quickest by those who understood the purpose of the different moves.³ The purpose caused the individual moves to hang together, so to speak.

¹ Pillsbury: *op. cit.*

² Binet: *op. cit.*, p. 264, p. 274.

³ Mr. Newman's article has not been published, but the manuscript was placed at the writer's disposal through the kindness of Prof. E. H. Lindley of the University of Indiana.

Binet¹ concludes with M. Goetz that the memory employed in games without sight is above all a memory of reason and calculation, or more concretely, that one does not remember that he has moved his king at such and such a time, but remembers a certain project of offence or defense in accordance with which he has moved his king. He qualifies this in part, however, by the statement that sometimes individual moves which make a deep impression on the mind and awaken astonishment are recalled individually. One retains a game of chess as he does a printed line or paragraph; the meaning and not the individual letters or words are what is retained.

Both Taine and Binet have studied the question of the visual representation of the board by the blindfold player. Taine concluded that such a player sees the board and the pieces on it as in an "interior mirror." He quotes an unnamed American to the effect that at the beginning of a game he sees clearly before his mental eye, the board and the exact appearance of each piece, and that after the announcement of each move he sees the pieces in the new arrangement, in exactly the same way.² The method of Dr. Tarrasch is thus described by Binet:³ At the start he represents the board in its original condition. When he makes the first move he sees the board thus modified and keeps the new impression in his mind's eye, and so on through the game, his mental picture changing with each move. Binet's correspondents, with one exception, answered that they used visual memory in playing without sight. He concludes from their answers that there are two forms of visual memory used in blindfold chess, which he designates as concrete visual memory and abstract visual memory. Players who make use of the former see the forms and the colors of the pieces and squares on the board exactly as they are. Abstract visual memory is described as follows: Most of the players see the board mentally. The mental image is localized before the player, but he apperceives at one time only the part of the board where the interesting features of the battle are taking place. The board does not ordinarily have a particular form. It is an abstract board composed of sixty-four squares. Very often the edges of the board are not seen. For some players certain diagonals, having particular importance for the game, are seen more clearly than others. Often the colors of the squares are not clearly seen, but become grayish, one color being a little brighter than the other. The form seems to be the element which is the most difficult to efface from the mental image.

¹ Binet: *op. cit.*, pp. 270 ff.

² Taine: *On Intelligence*. New York, 1899. pp. 38, 39.

³ Binet: *op. cit.*, pp. 276 ff.

What Binet calls the geometrical notion often takes the place of color. Binet's correspondents are unanimous in the opinion that they represent to themselves the positions of the pieces and their spatial relations and that no combination would be possible without such representation. Charcot gives the name "geometrical visual memory" to that kind of visual memory which simply conserves the positions and the movements of the pieces.¹

In agreement with Binet we may say that this kind of memory is the work of abstraction and results from the direction which the player gives to his attention. Form and color are neglected because they are of little importance. This abstraction, as Binet points out, is comparable to that in daily life where we gradually eliminate details and give attention only to essentials.

It seems evident from Binet's study, and from the statements of many chess players, that visual imagery in varying degrees of clearness from the most perfect representation to the most shadowy, is a very important factor in playing chess without sight, and that most players make use of it; but there is, on the other hand, data to warrant us in saying that it is not an absolutely indispensable factor. In other words, it is possible that a blindfold game could be carried on by a person entirely devoid of visual imagery. M. Goetz, in his paper published in Binet's book, says that visualization is almost entirely absent in his blindfold play and that his performance depends only on "reason and calculation."² For example, he knows from experience that a pawn on the king's fourth attacks one on his opponent's queen's fourth, and that a knight or a bishop on a certain square controls certain other squares; and this knowledge may be retained in verbal terms. Pillsbury, the greatest of all blindfold players, also asserted that he had little or no visual imagery and that he remembers each board and the positions on it not as a picture, but as a record.

Even in my own limited experience in blindfold play, I have found that visualization is an incidental and by no means essential factor. In my own case, in the beginning, visual images were entirely lacking, a little later they were present at times as the result of a conscious effort to call them up, and now when they are present they are so only in the most indefinite form. For instance, I have no mental picture of the board aside from its general outline, and the forms and colors of the pieces are never present, except when I have paid particular attention to them for experimental purposes. In the beginning, localization of the play was very indefinite and a replay-

¹ Binet: *op. cit.*, p. 311.

² Binet: *op. cit.*, pp. 340-351.

ing of the games with the board furnished many surprises both in this regard and in regard to the relative positions and distances of the pieces. At the present time the movements of the pieces and the localization of the play are fairly definite. I seem to feel the movements of the pieces, especially my own, as if I were actually moving them. Particular positions involving two or three pieces are sometimes seen in so far as the relative positions of the pieces are concerned. Normally I am a fair visualizer, but in blindfold chess my thinking seems to be largely of other sorts, and especially in verbal terms. When not engaged in actual play I frequently call up a situation with a fair degree of clearness, but when playing, verbal imagery is the most prominent in consciousness. For example, my opponent announces knight to the king's fifth. Ordinarily I do not picture the resulting position, but calculate the radius of action of the piece thus: knight on king's fifth attacks queen's seventh, bishop's seventh, etc. If it is advanced to queen's seventh it checks king at knight's first, etc., etc. It would seem that there is a closer association between the series of verbal images than between the visual images or the series composed of both verbal and visual images. My experimenting has not gone far enough, however, to furnish very much that is definite in regard to this aspect of the question. Without visual imagery the blindfold player would have to rely on word, letter and number symbols, and would have, it would seem, a much more difficult task than the player with highly developed power of visualization. In actual play, verbal memory plays an important part even for strong visualizers, for it is often by this means that they recall the actual moves that have been made when they are in doubt as to the position of any piece. My companion in the attempts at blindfold play made considerable use of visual imagery of Binet's abstract type, but used other sorts to a certain extent. I am inclined to believe that with increasing experience both of us would have made more use of verbal and other symbols.¹

In order to determine whether it would be possible to play chess with no visual imagery whatever, the following experiment was tried. Games were played without the use of either board or chessmen. The records were kept in the German notation, but in such a way that each player could tell the number and the location of the pieces on either side. The moves and replies were thought out as far as possible with the aid of this record and in terms of the symbols used. For instance, P a 5 attacks any pawn or piece on b 6; Kt c 3 attacks

¹ It may be conjectured that the necessary concentration of attention on the *relations* of the pieces rather than on the pieces themselves is partly responsible for the incomplete development of visual imagery.

b 1, a 2, a 4, b 5, d 5, e 4, e 2, d 1, etc. It was thus possible to calculate the relative positions of the different pieces and to attack and to defend any given position. The experiment was not long continued and visual imagery was never wholly absent, especially where attempts were made to form combinations. Nevertheless, I am convinced that it would be possible for a person to learn to play chess by means of verbal and number symbols alone. The task would be a very long and difficult one, but by no means impossible.

The Relation of Chess Skill to General Mental Ability. If chess is perhaps a tolerable index of temperament and character, is skill in chess also a reliable index of mental power in general? The reply must be qualified. Many able men are good chess players, but on the other hand there are those who live for chess, who think, talk, and dream chess, who confirm Edgar Allan Poe's observation that the best chess player may be only the best player at chess; but this number is small compared to the vast majority who indulge in it only as a pastime. Even among chess masters are to be found many who have displayed considerable ability in other lines. Dr. Emanuel Lasker, the present world's champion at chess, has taken his doctorate in mathematics. Tschigorin is a Russian government employee, Maroczy is a professor of physics and mathematics at a Budapest college, Tarrasch is a German physician, Anderson, at one time champion of the world, was a professor of mathematics, and Staunton, another world's champion and one of the best known of the older chess writers, is well known also as a writer and as an editor of the classics. Rousseau, Voltaire, Napoleon, and John Stuart Mill are said to have been strong players, and the historian Buckle an excellent one. The list might be increased almost indefinitely, but enough has been said to indicate that skillful chess players represent all walks of life, and that skill at chess is not incompatible with success in other lines. The chess player is usually something more than a mere player of chess. At the same time the cases of *idiots savants* in various forms of mental activity, and among others in chess playing, prevent the inference that skill in chess is a universally valid index of high mental endowment.¹

5. SPECIAL PSYCHOLOGY OF CHESS.

Forms of Mental Activity Required. We have now followed sufficiently, perhaps, the general aspects of the game, and can turn with advantage to its more intimate psychology. The aim of each player is, as we have said, to checkmate his oppo-

¹ See in the appendix to this study an account of a fair chess player of otherwise feeble intelligence.

nent, that is, to bring his own pieces into such a position that the opposing king could inevitably be taken at the next move. Each player must therefore carry out a scheme of attack, overcoming obstacles and preventing the blocking of his own plans, and at the same time guard himself from counter attack. The game in its most important portion presents in essence a succession of situations each of which calls for special examination, with reference both to its present and its future import, and the selection or invention of an appropriate line of action. The player asks himself continually, in effect, at least, what is this present situation and what ought I to do to meet it? The game throughout may be regarded as a series of reasoned inferences, expressed by moves upon the board. The present section will be devoted to an exposition of the logical and psychological relations in question.

The Stages of the Game and Their Logical Types. The game of chess proper is divided into three fairly well defined parts called the opening, middle, and end games. There are openings without number but all have been the subject of analysis for so long that one can obtain from the numerous books on the subject information limited only by his capacity to retain it. The competent player knows at least the chief openings and enough of their theory to meet any unexpected variation from the usual moves and replies.

The end game, in which the forces on either side are greatly reduced, has also received careful study at the hands of expert analysts, so that one may learn from the books to recognize certain situations and to know their possibilities. Geometrical figures have often been employed to show the possibilities of situations.

In the middle game, however, the player may no longer rely on definite directions, but is entirely dependent on his knowledge of general principles and his past experience. The former will be of service especially to the young player, but, owing to the infinite number of possibilities which may develop out of the different situations, experience in actual play is indispensable. Here the player must exercise all his ingenuity, must give rein to his creative imagination, and must follow out as far as he is able the effects of the different moves which suggest themselves. The chess player's skill is measured in terms of his ability to do all this successfully.

Opening and End Games. In the opening game and in the end game the logical type of reasoning is usually that of the categorical syllogism. In case of a typical opening it may be formulated as follows:

In all cases of the Evan's Gambit, pawn to the queen's knight's fourth is the fourth move.

This move is to be the fourth in an Evan's Gambit.

Therefore, this move should be pawn to the queen's knight's fourth.

Similarly in the end game the situation which develops recalls the procedure to be followed. If White, for example, has a king and a rook against Black's king, he must drive the latter to the edge of the board, hold him there with his king and mate with his rook. White's procedure may again be reduced to the type of the categorical syllogism.

All cases of king and rook against king are to be met by driving the latter to the edge of the board, etc.

This is a case of king and rook against king.

Therefore, this is a case to be met by driving the king to the edge of the board, etc.

All habitual actions may be reduced to this type and Professor Charles Pierce has remarked the same about all reflex actions.

The Middle Game. In the middle game, where general rules are only partially applicable, the logical procedure is mixed and will differ somewhat according to the grade of the player. In what follows immediately we shall assume the player's condition to be that of a not very skillful amateur; of the professional's condition we shall speak later. So far as general rules apply to the middle game, the play will be of the deductive type which we have just illustrated, but in the vast majority of cases it will be more complicated. The situation is not of the known sort that invites application of general rules, but of an unknown sort in which the essential features (or true meaning) must be disentangled from a mass of obscuring details, and when disentangled must be met by a move or a line of play especially selected, or invented, for the purpose. The logical type is not now simply deductive, but really a series of logical steps resembling the sort of scientific procedure which Jevons, for example, calls the "Combined or Complex Method."¹ An hypothesis is first formed, deductive inferences drawn from it, and these tested by experiment. The player finds before him a situation created by the last move of his opponent. His study of the situation gives it a certain character in his mind equivalent to the formation of an hypothesis with regard to it. He then reasons: This is a situation of such and such a sort and therefore to be met by such a move in reply. The move in reply is then tried in imagination. If it seems successful it is accepted and actually made; if it is seen to be unsatisfactory, it is rejected and a better one sought for the same purpose, or

¹Jevons: *Lessons in Logic.* New Ed. London and New York, 1905.
p. 258.

what is more likely, the hypothesis itself (the conceived character of the situation) has been changed by the evident unfitness of the move imagined.

Skill is shown in the opening and end games by the readiness with which the player recognizes the common situation and draws from memory the appropriate response. Skill in the middle game is shown by the readiness with which he recognizes the essential features of a new situation, and, in his inner experimentation, hits upon a move that fits the case, *i. e.*, proves by its appropriateness that his diagnosis of the situation was correct.

This is the condition of the commonplace player. The case of a perfect player, one with chess omniscience, whose analysis was perfect, who could see the game to the end at any stage of it, would be quite different. Having a perfect plan of procedure for every case, he would play throughout very much as the amateur plays the opening and the end games. Excellence in play ranges upward from the condition of the amateur toward that of the perfect player. To the chess master many of the situations that arise in the middle game are already familiar and the best means of meeting them known. Others will be unknown; and then the crucial point of his opponent's attack must be discovered and an appropriate response devised. His play is for the moment of essentially the same type as that of the amateur, except that he is both by nature and experience much more prompt in discovering the essential feature of the attack and much more resourceful in finding means of repelling it.

Let us, however, return to the logical type employed by the commonplace player. The type followed in the opening and end games would correspond closely to the typical logical procedure as described by James.¹

The type followed in the middle game differs from the formal sketch of James which has in view reasoning of the deductive type. Here the essential characteristic of the situation, even when discovered, does not suggest any well known group of similar cases to which it may be referred and for which a definite mode of procedure has already been worked out. The essential characteristic can at the most suggest only a very general kind of procedure; it gives no inkling of just what should be done. The player knows that he must sacrifice the threatened piece, or withdraw it, or intercept the attack, or make a counter attack, but which of these is best must be thought out for each situation. His usual method is to try in imagination one move after another until he finds one that seems superior

¹ James: Principles of Psychology, N. Y., 1899, Vol. II, pp. 330 ff.

to all the rest. And often it is only during this experimental process that the full signification of the situation dawns upon him.

Such reasoning is concrete and practical, not put into words, or only partially so, and allied to the reasoning of animals and children.¹

But, as Morgan well shows, the logical reasoning of man is largely dependent on the need of communication and the use of language;² a chess game *played* is reasoned in particulars; the same game *explained* and *defended* to a companion would be cast in verbal and syllogistic form.

Psychological Restatement of the Logical Types. This last remark touches upon an essential point to which we must give yet a little further attention, namely, the difference between the logical types of reasoning and the actual psychological processes which they symbolize. All processes of reasoning are, as psychological facts, sequences of mental states due to shifting of the focal point of attention and to processes of association dependent thereon. In the deductive portions of the game—the opening or end game, where the play is guided wholly by rule—the process is one of serial association running off under the general influence of the conception of the opening (or end game) which remains in the background of consciousness. Each move suggests the next in fixed sequence, as one might say the alphabet, having in the background of his consciousness the desire to say it.

For the middle game let us take a concrete example. Let us say that it is Black's turn to move. He glances at the board and notices the queen and knight of his opponent in position to develop a double check upon his king. Association, under the guidance of his general knowledge of the purpose of the game, freely suggests the consequences, if he cannot in some way interfere. Attention then shifts to the response to be made and association again coming in suggests the readiest means of defense. In other words, the situation, regarded from the point of view of defense and held in the focus of attention, recalls by association a number of possible moves. These associations, following, of course, the readiest lines of habit, are not by any means at random, but operate strictly within the limits imposed by Black's knowledge of the general rules of play and his present intention. Each of the moves suggested is itself brought to the focus of attention, is tried in imagination, probably by incipient movements of eye or hand,

¹ It is what Romanes calls reasoning in particulars. Romanes: Mental Evolution in Animals. N. Y., 1900. p. 337.

² Morgan: Introduction to Comparative Psychology. London and N. Y., 1902. pp. 293 ff.

and accepted or rejected as the case may be. If accepted, it is put into execution in the same manner as other voluntary movements.

The mental action of the player in such a situation is analogous to that of the inventor. A half finished machine stands before him; his problem is clear; he must cause such and such movement in such and such parts in order to bring about a desired result. He runs over in his mind the varieties of pulleys, cranks, gearings, cams and the like with which he is familiar, and finally selects one or the other as the most likely to accomplish what he wishes. A high grade of skill as an inventor or as a player of chess involves the utmost readiness in seeing just what needs to be done and in discovering the means of doing it. Experience helps immensely in both of these directions; and it brings many cases under fixed rules so that they are dealt with by simple associations and correspondingly reduces the number of cases that must be treated as singular and without rule, and greatly enriches the fund of expedients that may be tried in such singular cases. When the case is so unfamiliar that experience suggests nothing, the reasoner is reduced to simple blind fumbling, on a level with that of the brutes, and rational procedure reduces to the "method of trial and error." The situation arouses an impulse to do something; there is a blundering attack; efforts that lead to unpleasant consequences are rejected; those with pleasant consequences are repeated. Man's more complex mechanism of apperception, his wider range of associations, and his power of imaginative action all combine to reduce the cases where blind fumbling is necessary, but when these powers are of no avail there is but one method, and that is the method of lucky hits.

II. THE PSYCHOLOGY OF THE LEARNING OF THE GAME.

1. *General Description of the Learning Processes in Chess.*¹

In the preceding sections have been set forth what I conceive to be the general outlines of the mental activities involved in chess playing. It is popularly believed that chess is a very hard game to learn, that it is difficult for every one and impossible for many. To a certain extent this is true. Chess is a difficult game, but it is so because it requires a peculiar mental equipment, rather than because it calls for one of an especially high order. First and foremost is required a liking for chess. The man who finds it uninteresting may as well give it up at once. Next it requires powers of sustained attention and an

¹ My sources of information here are my own introspective notes while learning to play, and those of four assistants, together with the replies of my correspondents.

excellent memory;¹ and based on these, considerable powers of analysis, and visual imagination, or its equivalent in some other sense department.

Increase in skill means increase in the knowledge of chess situations and how to meet them; or, in more psychological terms, increasing "meaning" in certain arrangements of the pieces,² and increased facility of association between these meaningful arrangements and certain other arrangements (moves to be made) imaginatively constructed; or, in still other terms, more adequate apperception of the situations and richer and better organized associations connected therewith. These organized apperceptions and associations insure truer and prompter apprehension of the difficulty to be met and better and prompter selection of the means to meet it. Skill is largely, though not wholly, in proportion to knowledge, and knowledge in proportion to experience.³

The player's progress may be divided roughly and for purposes of description into five stages. (1) The first step is to learn the names and movements of the pieces. The former is easily done, but the latter requires a trifle of practice before the pieces can be readily used in play. This is especially true in the case of the knight.⁴ For successful play the moves must, in the end, become automatic, and this automatism is not reached, as the game is usually learned, in the first stage itself. It depends for its perfecting on the practice obtained in succeeding ones. This probably is the natural method in all learning, the greater interest of the advanced stages floating the learner over the drudgery necessary for complete perfection of the automatisms of the earlier. When the moves have become automatic the men are no longer pieces of wood, jade or

¹ These last may not seem absolutely essential in view of the case to be described in the appendix, but even from that case I shall hope to show that this statement is justified.

² Stout: *Manual of Psychology*. N. Y., 1899. pp. 84 ff.

³ I say "not wholly in proportion to knowledge," because skill represents only that part of knowledge that can be readily and effectively applied. Our general problem in this section is, therefore, to describe, as far as we are able, the way in which experience becomes transmuted into skill. Our immediate concern is with chess skill, but if we are successful in our study of that, we shall be justified in certain inferences with regard to many other sorts of learning which, like it, are matters of mental as opposed to purely physical training.

⁴ Knowledge of checkers is at first a source of many interferences. The player is tempted to move his pawns diagonally, has a tendency to keep his pieces bunched so that his opponent cannot "jump" them, is on the lookout for vacant squares on which to plant his pieces, and has a tendency to clear the board as soon as possible. He also finds it difficult to remember that the pieces can retreat after having been once advanced.

ivory,—static things—but *forces* capable of being exerted in definite directions.

(2) The second stage may be characterized as the stage of individual moves of offence and defense during which the beginner plays with no definite aim other than to capture his opponent's pieces. Even this he blunders about, often overlooking for several moves a chance to capture a man that has been left *en prise*. My notes contain many entries showing two bishops, both unprotected, left facing each other for several moves, or a queen moved within range of a bishop or a knight. The player is able to attack one of his opponent's pieces and is able ordinarily to defend himself against direct attacks. Whichever he attempts to do he must give his whole attention to it, and even with this extreme of concentration he is able to see only the immediate consequences of the move. In general, however, his lack of conception of the aim of the game, causes him to play at random. His play lacks unity and the pieces are moved hither and thither, unsupported and unsupporting; he has no conception of the game as a well planned sequence. Nevertheless he has hovering in the background of consciousness some idea of the ultimate object of the play, the hemming in of the adverse king, and is influenced somewhat by it.

(3) The beginner is soon able to tell at a glance what any single piece can do, but no one piece, not even the queen, is very strong unless supported by others. Hence the task in the third stage of the beginner's progress becomes that of learning the strength, not of individual pieces, but of pieces in relation to each other. He has to learn the value of groups and the value of individual pieces as parts of particular groups. There are times when a bishop or a knight or even a pawn may be so situated that its direct influence is greater than that of a rook or a queen. Many of the most fascinating of the recorded games are those in which one player has actually given away one or more of his pieces, often his queen, in order to gain the advantage of the relative positions resulting from the movement of the pieces involved.

About the time the beginner has passed beyond the first two stages of his learning and during the third, the idea of checking becomes the dominating one with him and his efforts tend to centre upon that exclusively. This, of course, leads to premature attacks which usually result disastrously to the aggressor. He is also prone to fix his attention on his own plans and most likely on the particular part he is about to execute at the moment, to the neglect of all others. He suffers from inability to take in a number of details at the same time. They have no meaning except as details, and if he concentrates on one, others must, by that very fact, be neglected. He has

ittle idea of the importance of developing his pieces, *i. e.*, making them available for future offence and defense, and of the value of position. The attack of his opponent compels some defensive play, however, and no defense can, of course, be made without the co-operation of at least two pieces, so that he soon learns something of the use of pieces in combination. He learns, for example, that often a piece may defend another and at the same time attack one of his opponent's pieces, that in some cases where two pieces are attacked simultaneously one may be withdrawn and so placed as to protect the other, and that a counter attack is often the best defense.

He has made considerable progress in this stage when he is able to give attention to the plans of his opponent beyond those that are immediately connected with his own, though in this particular, temperament plays a large rôle. That this is the usual experience, however, is testified by the fact that after a player is able to form a definite plan of his own involving some use of combination, he is often surprised by checkmate when he is within a single move of checkmating his opponent. He is unable to carry out his own plans and at the same time to give attention to anything else; he is particularly weak in defense.

In general we may say that the beginner at this stage is not able to play in proportion to his knowledge. He recognizes his errors when they are pointed out to him, but he is unable to avoid them. My records show many familiar blunders occurring over and over again. The beginner's material of knowledge is not organized and therefore not available in any situation except the most simple.

(4) The player has entered upon the fourth stage when he begins consciously to plan the systematic development of his pieces. This necessarily involves some knowledge of the value of position, which knowledge we may call judgment of position. These judgments are generalizations and are the result of the player's own experience, or have come to him in the form of general principles from the experience of others. However they may come to the player their possession is absolutely essential to further progress. Now the player no longer has to puzzle himself by attempting to consider all the possibilities of the situation, a thing he is utterly unable to do, but he applies his principle. His principles, especially those he has formulated for himself, are usually only partially true and have to undergo constant modification as his knowledge and experience increase. He knows now a number of definite situations and his plans radiate from these and are more far reaching. He is also in a position to give more attention to the moves and, indeed, to the general plans of his opponent. This is a consid-

erable advance, for it means that the player's mental horizon has been extended very much and that he is able to disregard the non-essentials to a greater extent than before. Given positions assume more and more importance and one of the great marks of improvement is the development of "position sense."¹

(5) As we have already pointed out, "position sense" is a result of experience, and as such is the product, we may almost say the culmination, of one's whole chess development. Nevertheless, a fairly good knowledge of the value of different positions marks such an advance over the player who is in what we have called the fourth stage that it may be taken as the fifth in the player's course of development.

The stages mentioned above are somewhat arbitrary, and may not be followed exactly in individual cases, but they will at least give some indication of the course of the player's development, which may be summarized in brief as follows: First the names and moves of the pieces are learned. Then comes the period of blunders, of indefinite play, of premature attacks, and of concentration on single moves, particular situations or, at best, on a plan imperfectly worked out. Later, one is able to see farther ahead, to foresee results more accurately, and to give some attention to the plans of his opponent. At the same time some typical forms of attack and defense and some general principles, or supposed principles are being learned, together with some knowledge of position. Along with all of this, though appearing consciously much later, goes an ever increasing power of analysis and improvement in "position sense."

Some of the most common blunders or oversights of these early stages are leaving pieces *en prise*, *i. e.*, unprotected and in a position to be captured on the next move of the opponent; allowing two pieces to be attacked simultaneously by one piece; removing a guarding piece, resulting in the loss of the guarded one; allowing a piece to be "pinned," *i. e.*, leaving it in such a situation that either it cannot, under the rules, be moved at all, or only with loss of an important piece. Errors of a more general nature are overlooking the bearing and force of distant and far-reaching pieces, errors in pawn play, not correlating the pawns and pieces, blocking the radius of action of the men, forgetting the purpose which prompted the placing of a piece in a certain position and a consequent loss of time in replacing it, or a disorganization of forces, and finally, faulty combinations and unsound sacrifices. Many blunders arise at all stages of skill from haste, impatience, and impulsiveness, but they are especially numerous with beginners.

¹ *Vide*, p. 277.

2. Discussion of the Learning Process.

We have now given an account of the stages of learning ; it remains to speak more particularly of the psychology of the learning process. Our problem is to explain the development of a beginner, who knows merely the names of the pieces and their powers, into the skillful player who makes use of these simple elements in intricate and purposeful combinations. We have to do with the growth of skill in strictly mental operations within the limited field of chess play.¹

Obviously, memory is the *sine qua non* of learning, but although of prime importance it is only one of the factors involved. It must be such a memory as leads to the organization of the mental materials rather than to their mere retention. One could not be far wrong in saying that mental skill is in direct proportion to the degree of this organization. How organization can best be brought about is still an open question, and indeed its answer would involve the entire psychology of pedagogy. Its ultimate nature we do not know. To a great extent the material organizes itself, *i. e.*, the organization is physiological and a matter of growth. This fact was clearly pointed out by Dr. Burnham, who holds in his study on "Retroactive Amnesia"² that impressions require a certain time in which to fix themselves. The growth process, fixing the impression and strengthening the association tracts, is an indispensable factor in learning. A multiplicity of impressions might be made to follow so closely on one another that none of them could become fixed. In that case, of course, nothing would be learned.

¹Numerous studies have been made on memory, attention, and other complex mental processes and a considerable number on learning, but these latter have been concerned chiefly with motor training. Bryan and Harter's study on the learning of the telegraphic language among the earlier studies, is the nearest approach to the present one, but it deals more especially with a sort of learning which is of a mixed motor and sensory type, whereas the skill here in question is almost wholly central. In that study learning on the sensory side consisted in the formation of fixed associations between complex sounds and the corresponding words; in our case the learning process involves the formation of complex groups rather than that of fixed associations of symbol and word. Nevertheless much of what Bryan and Harter discovered in reference to this latter sort of learning is strictly applicable to the form with which we are dealing, especially their chief generalization, namely, that advance in skill depends upon the formation of a "hierarchy of habits." Among the more recent studies, that of Swift, on Beginning a Language, in the Garman Commemorative volume (*Studies in Philosophy and Psychology* by former students of Charles Edward Garman, Boston, 1906) may be mentioned as dealing like this with a form of mental skill.

²Burnham: Retroactive Amnesia, *Amer. Jour. of Psy.*, Vol. XIV, 1903, pp. 382-396.

In this connection I may mention that the returns of my correspondents also indicate that short periods of rest from chess practice, varying with the individual from a few weeks to several months, may cause a noticeable increase in skill. Renewed interest and consequent greater effort in beginning again after an interval of no play may account for this in part, and it may be also that in constant playing the details accumulate faster than the mind can assimilate them, so that they confuse rather than aid the player. This seems plausible when we remember the difficulty the beginner has in applying known principles to a mass of details. Then, too, when the stress of new impressions ceases, an opportunity is given to take an inventory of the mental stock. This is not possible to any great extent when new impressions are crowding in, and the attention is fully occupied with them. On the other hand, long periods of inactivity have a very different effect. Players make blunders in the openings, their combinations are not so far reaching, and a greater effort is required. Every part of the game that requires pure memory is affected and it is often necessary to do consciously what had previously been automatic. This, however, has to do merely with the fixation of separate impressions and of ideas with their associates, and our problem is rather to account for the combination of these elements into larger and larger complexes. On the physiological side little is known. The most that can be said is that increasing complexity of nervous function parallels increasing complexity of mental function. However that may be, our explanation, for the present at least, must be sought on the psychological side.

If we omit the very earliest stages in the chess player's development, the first significant fact is the beginner's utter inability to use in actual play what little chess knowledge he possesses. His blunders are recognized at once when they are pointed out to him, but in spite of his resolution to avoid them, he finds himself committing the same ones over and over again. It seems that the more he tries to avoid them the more blunders he makes. The intensity of his effort and the deep interest he takes in the game precludes mere carelessness. His difficulties are not due to lack of attention, but to the concentration of the attention on one feature of the game to the neglect of all the others. He sees this single thing and nothing more, because it, of all the mass of impressions, has some meaning for him. Were it possible to determine the span of one's chess attention during the different periods of his progress in learning, it would be possible to give objective evidence of the progressive fusion of the different elements into larger and larger complexes. The course of development would extend from the stage in which

the player is unable to see in their completeness even the immediate consequences of a single move to that in which he is able to take in at a glance the disposition of all the pieces on the board. The building up of mental complexes in learning chess and those involved in other sorts of learning are not essentially different. There is a close analogy, for example, between the chess player learning the moves and blundering through his first few games, and the child learning to read, or the telegrapher learning to send and to receive messages.¹ The letter, the telegraphic dot or dash, or the single move in chess is at first the unit of perception. Later the word, a series of dots and dashes, or the relation of two or more pieces to each other becomes the unit. The child learns later, possibly, to comprehend at a glance the meaning of a phrase or a sentence; the telegrapher to receive by phrases; the chess player to take in a whole situation at a glance. Not only has the unit of perception become larger and larger but it has become more and more meaningful.

Perhaps the analogy is closer still between the chess expert and the mathematician who has merely to glance at a formula or at its first two or three terms in order to recognize its full import. Every situation in a game of chess which requires readjustment of the player's plans is a problem for him, and the quickness and the accuracy of his solution will depend upon his ability to seize upon the salient and essential features and to neglect those which have no meaning for that particular situation. Obviously the mathematician's skill, when confronted by a problem, will display itself in his ability to recognize the fundamental nature of the problem. Lindley found that an expert mathematician, among those who attempted to solve his puzzle, recognized at a glance the mathematical principle involved and solved it without difficulty.² He displayed what corresponds to "position sense" in chess. The chess player has this advantage. In any particular game he has built up or helped to build up his own problem and has a mental record of its progress. He has seen the possibilities of certain lines of play eliminated one by one and is thus able to concentrate on the remaining ones.

The expert chess player is not required to analyze each position as he comes to it, and, indeed, this would be impossible to any great extent. His mind grasps the situation as a whole and it has a definite meaning for him. He recognizes the salient features only and deals with them, the details having for the time being dropped out. He is in the position of the general who has to know not that in one part of the field he

¹ Bryan and Harter: *op. cit.*

² Lindley: *op. cit.*, p. 470.

has a regiment of one thousand soldiers, divided into ten companies of one hundred men each, but that he has a force there sufficient to repel any ordinary attack. He has only to pay attention to the regiments and their condition when an emergency arises. The expert no longer deals with particular terms, but with general terms or concepts. These general terms have been built up step by step, their meaning changing with the ever increasing knowledge of the player, and are often represented partially or symbolically by their initial moves or general trend. More concretely, a player learns at first that a certain move is a good one because it has certain definite advantages, and this enables him to plan a little further ahead. Later he finds that this move has a great many other consequences, and perhaps this in turn modifies a general principle he may have based upon it, and this finally, may involve the modification of several other principles and result in a still more comprehensive principle embracing all of the others. Details can be organized into larger groups in proportion as they gather meaning as a group, but not before. The chess player groups his pieces and they acquire a meaning analogous to the potential meaning of the general term or the symbol in abstract thinking. Progress in chess like progress in abstract thinking of any other kind consists in the formation of an increasing symbolism which permits the manipulation of larger and larger complexes.

We are in the habit of speaking of the automatic in the motor realm, meaning by it that certain movements or combinations of movements are carried on without conscious guidance. Is there such a thing as automatism in the realm of the purely intellectual? It seems to me that this question is to be answered in the affirmative. There is something in the purely intellectual life corresponding to motor automatism, which is shown in the ability to think symbolically or abstractly, and thus to handle large masses of detail with a minimum of conscious effort. It involves the increasing ability to take in during a single pulse of attention a larger and larger group of details which means, of course, that the attention is no longer needed for each one.

An apparent difference between motor and mental automatisms, lies, however, in the fact that in the intellectual realm increasing automatism seems to involve the dropping out of details, while in the motor realm increasing automatism often means a greater perfection of the details. Careful examination, however, will probably show that in both details are dropped from consciousness and that in both they are perfected in the externalized outcome. The great feature common to both is the releasing of the attention from the details. In the intel-

lectual sphere, as the processes become more and more complex, they are carried on by systems of symbols which tend to become more and more abstract or general. This is true of all abstract thinking, including that involved in expert chess playing. And, as in all other kinds of abstract thinking, it is essential in chess that no matter how symbolic the thinking may become the player must always have a thorough grasp of the details of the game. In other words, he must not only be able to construct his plans by the use of abstract symbols, but he must be able to translate them into the concrete and to carry them out move by move. This latter he does not necessarily do in his thinking. From one whole situation he passes directly to another whole situation. For instance in a definite situation, the first move of a long series suggests not the next move but the position after the whole series has been played. In other words, the first term does not necessarily call up the second one or the last, or some intermediate term, but the result of all the moves. This final result may be present to the mind in the form of a visual image (a mental picture) or in verbal terms. For example, the first few moves of the Evans gambit already mentioned, may cause to arise in the mind of one player a visual image of the position as it will appear after a dozen moves have been made on each side, while in the case of another player a verbal judgment of the strength or weakness of the final position may take its place. To the latter player this opening calls to mind a verbal judgment of the final position based on past experience. The formulation of principles of play, which become increasingly general, is another expression of the increasing symbolism involved in learning to play chess, but in this case in verbal instead of visual form.

The chess player's skill is measured largely in terms of his ability to use larger and larger units of thought. He has learned by means of many repetitions, a series of moves in regular sequence, later, as has already been pointed out, the first move or a given arrangement of the pieces on the board represents for him the position as it will be several moves further on. All the intermediate steps are for the moment ignored, or, in other words, "a short circuit" has been established and the association is between the first term and the last or the total result instead of each term being revived by the one immediately preceding it.

In trying to explain this from the physiological side two alternatives present themselves. It may be that an entirely new brain tract, connecting the first term with the last, has been opened up. On the other hand it is just as conceivable that the nervous impulse may travel along the same path in all cases and that in the case of a "short circuit" only the first

and last terms rise into consciousness. Experiments on the learning of nonsense syllables, showing that repetitions not only strengthen the associative bonds between a syllable and the one immediately following it, but also between more remote ones,¹ seem to lend a certain support to the latter theory. This is, however, all rather speculative since neurology is able to tell us little or nothing about it. On the psychological side the "short circuiting" process seems to mean something like this. In the beginning the last term, the final result, is reached after passage through all the terms of the series. Now, ordinarily, the series is of value, and therefore of interest, not for itself, but for its result, so that little attention is given to the intermediate links, but much to the getting through. The whole strain of attention is forward. As a result of this the image before the mind may be several steps in advance of the one actually being executed, or, in well practiced series, it may be the last step itself, or even the purpose for which the series is gone through. The result is that there is a tendency to the formation of immediate associations between the earlier and later steps of the series. This suggests that conscious effort plays an important part in the establishment of the "short circuit." Bryan and Harter, in their study of telegraphic language, concluded that only by putting forth a supreme effort could one rise above the plateau of moderate attainment.² Still it is by no means certain that the rise in the curve would not take place in time if effort were maintained at a moderate and uniform level. In that case the rise in the curve from the plateau would mean the completion of the growth processes under the guidance of ordinary selective attention.

While chess is a type of purely intellectual learning, the fact should not be lost sight of that the emotional accompaniment is an important factor in the chess player's development as in all other sorts of acquisition, and that emotion is one of the strongest influences in fixing impressions. Ideas which are associated with strong emotions are kept before the mind for a longer period than those which have little or no emotional coloring and thus have much more chance of becoming permanently fixed. Numerous instances were noted in this study in which situations which had aroused strong emotions were continually before the mind and were so persistent as to banish sleep and to drive out all other thoughts.

In this connection mention should be made of the effect of error on one's progress. If one continues to commit errors

¹Ebbinghaus: *Ueber das Gedächtniss.* Leipzig, 1885.

²Bryan and Harter: *op. cit.*, p. 50.

through ignorance of the fact that they are errors, he may retard his development by falling into fixed habits of unsound play; but if they are noted as errors, and especially if they arouse a strong emotion, they are eliminated. The importance of this becomes evident when we recall that a great part of the player's progress consists in the elimination of unprofitable moves. It is easy to see, also, that emotions, so far as they are expressive of temperament and affect one's habits of play, may exercise an important influence for good or bad upon one's ability to win, as already pointed out in any earlier section.

3. *Aids to Learning.*

By study and practice the difficulties of the beginner are gradually overcome and his faults corrected, though the latter are apt for a long time to recur at unguarded moments, and some, especially the faults of temperament (errors and oversights due to impulsiveness, rashness and quick temper, for example), may never be wholly suppressed. It is probable, indeed, that most of the faults of the earlier stages are temporarily overcome many times before they can safely be given over to the realm of the automatic, *i. e.*, they crop out from time to time when the attention is turned toward larger complexes of elements.

Of all the aids to learning, so soon as one has mastered the bare rudiments of play, there is probably nothing like actual play over the board, provided that one is willing to play slowly, study out the causes of his misfortune and profit by them. The emotional stress attending both success and failure at such a time is a great aid to memory, as has already been suggested.

The concrete criticism of a superior player is of the greatest assistance, but too many things must not be given at once, and what is given must be applied immediately in actual play in order to insure its retention.

In order to get some idea of the sources from which chess players gain their knowledge of the game and the value which they attach to them, questions were asked of my correspondents in regard to the benefit derived from problem solution, the study of standard games, end games and openings, and board play under different conditions. Most, of course, had derived most of their knowledge from actual play over the board.

The interest in problem solving is by no means universal. Many state that they have never attempted to solve problems; others, that they are not interested in them because they are artificial and mechanical and do not help one's general play. The replies indicate, however, that problem solving is widespread among players. As to its helpfulness in general play, the variety of opinion is great, varying from the statement that it is a positive detriment to extravagant claims for its utility for mental development in general. With a number of players, the problem interest, if developed at all, was developed late, *i. e.*, long after they had learned to play. It is interesting to note that few of these players think that problem solving has helped their play. Others took up problems with the beginning of play and say that they were greatly helped by their efforts to solve them. This suggests what is probably the fact that solving problems helps one in the early stages of his play, and this is in accord with my own experience. The reason for this is not hard to find. The history of problem chess shows that in the beginning the problems were merely positions

taken from actual games and consequently involved all the elements of actual play. Much could then be derived from their solution which would be of general service. Since that time, however, problem composition has changed very much, and the problems now are made to conform to certain fixed rules, which have, from the standpoint of many players, made them mechanical and artificial. They have lost most of their resemblance to positions met with in actual play. No doubt they are not of much benefit to players who have had considerable experience and who are familiar with the principles involved in their solution. With the beginner, on the other hand, the case is different. He may learn something of the manner of giving check, something of the powers of pieces in different combinations, and of the value of position. They may help his powers of analysis in so far as they involve general principles which are applicable to actual play, and they may aid in improving his judgment of position. At the best, however, they are far inferior to the study of end games and to actual practice over the board. This latter statement seems borne out in part by the fact that few, if any, great problem solvers or composers are also great players.

Practically all agree that a knowledge of the openings is indispensable. The advantage is evident. It enables one to place his pieces in good positions relative to each other, to develop along sound lines, to avoid disaster in the early stages of the game, to take advantage of weak moves made by one's opponent, and what is also of great importance, it enables him to play with a minimum of effort during the early stages of a game. It should be added that knowledge of the openings and variations helps one to force the play along lines with which he is most familiar. The easiest and quickest way to get this knowledge is from the books, but many good players possess it who have given little or no time to book study. They have gained it from actual experience, and base their opening plays on principles derived from this source.

A few think that replaying standard games does not help one's play, and a still smaller number think it is a positive detriment, assigning as a reason that it destroys one's originality, and causes him to overlook advantages which slight variations from the known lines might give. There may be a real danger here, but it is more than offset by the advantages gained. Among the advantages are mentioned the opportunity to examine positions at leisure, to study comprehensive plans of attack and defense involving particular combinations, to appreciate the value of time and position, and finally to become familiar with a number of oft-recurring situations. These situations, while seldom identical, are often similar. Standard games also teach principles and aid in the development of position judgment. It should be stated, however, that the value of such games varies with the individual, and up to a certain stage is in direct proportion to his chess knowledge. The mere beginner learns little from them; the chess master also learns little from them. The one is unable to comprehend them; the other finds little in them that is unknown to him. The games take on meaning in direct proportion to the amount of knowledge that one brings to them; and their value to any individual depends on the number of new ideas he is able to carry away from them.

Playing with a weaker player is not considered a good thing by most of my correspondents. They say it makes them careless, prone to recklessness, and leads them into all sorts of extravagancies of play. Several recommend never playing with a weaker player without giving sufficient odds to make the game even. A few recommend playing with a weaker player for the reason that, by lessening the amount of

attention ordinarily given to the opponent's plans, the stronger player is able to give freer play to his imagination than he would dare to do if playing with one of equal strength.

Most say that playing with many different players has made their style more flexible. A few, however, maintain that style of play is individual and that nothing can change it. This contention, as was pointed out above, is undoubtedly true in so far as fundamental traits of character enter into the game. Those who answered that playing with a number of different players has made their style more flexible, appear to mean that to a certain extent it has enabled them to overcome some faults due to temperament and that they have learned a greater variety of methods of play.

III. GENERAL SUMMARY OF THE PSYCHOLOGICAL POINTS.

Chess as a strongly competitive form of human play appeals to the fundamental fighting impulse, but it appeals also to the æsthetic and puzzle-solving interests; and it affords the pleasure of "being a cause."

Visual imagination is an important element in chess playing, especially in blindfold chess, but it is not indispensable. Motor, verbal, or auditory imagery may, and often does, occupy the chief place in the player's consciousness.

The mental qualities most utilized in chess playing are: a strong *chess* memory, power of accurate analysis, quickness of perception, strong constructive imagination and a power of far reaching combination. These are *chess* qualities, however, and skill at chess is not a universally valid index of high mental endowment.

The logical type differs in the different stages of a game and with the knowledge and skill of the player, approaching always nearer, as his knowledge and skill increases, to that of the syllogism.

The reasoning process is, in psychological terms, a sequence of mental states due to shifting of the focal point of attention, the associations working strictly within the limits imposed by the task or purpose.

In his learning the chess player passes through well defined stages and these mark the necessary steps in his progress. The most important psychological feature in the learning of chess (and it seems equally true of all learning), is the *progressive organization of knowledge*, making possible the direction of the player's attention to the relations of larger and more complex units. The organization involves generalization, increasing symbolism, and the multiplication of associations; it insures prompter recall and increased potential meaning in the general concepts; it releases attention from details and favors consequent mental automatisms and "short circuit" processes. Thus alone is progress possible. Mental automatisms are usually perfected, one may conjecture, after advance to the next higher stages of learning.

APPENDIX: ON THE CASE OF A FEEBLE-MINDED CHESS PLAYER.

During the course of this study several cases of chess playing among the feeble-minded have been reported to the writer, but it has been impossible to secure definite data except in one case. It is said that in some instances a very high degree of chess skill was possessed by men of very low mentality. An inmate of the Wisconsin Institution for the Feeble-minded, is reported to have been able to cope successfully with very strong players. Very likely the strength of these players has been very much overestimated, but the evidence is sufficient to warrant us in saying that in chess as in other kinds of mental activity a peculiar power is not incompatible with a very low average of general mental ability.

The writer has been able to study at first hand one case of chess playing by a man of low grade intelligence who is an inmate of the department for the feeble-minded and criminally insane at the Massachusetts State Farm. In the asylum records he is classed as a congenital idiot who has suffered degeneration since coming to the institution in 1891. Previous to that time he had been an inmate of other institutions for the insane. He has had and still has, though less frequently than formerly, outbursts of rage, at which times he beats his head against the wall. He says he does this because he loves his mother. He is a sexual pervert and some of his outbursts followed his separation from other inmates of the institution whom he designates as "friends." He is fifty-four years of age but looks much younger, is filthy in his personal habits, and presents a very peculiar appearance. He stoops considerably and walks with the shuffling gait characteristic of the feeble-minded. In one of the older asylum records some one has noted the fact that he resembles an anthropoid ape in appearance. His forehead is very low and receding, his maxillaries are very protruding and the posterior portions of his head are so prominent that his head resembles that of the African negro.

The term idiot is used to cover such a wide range of mental deficiency that it conveys no very definite meaning, so that it will be necessary to give a brief account of his attempts at mental work in order to convey some idea of his general intelligence. His memory for some things is fairly good, though it is not of special excellence. He remembers faces quite well and for a considerable time. He also has a fairly good memory for places, remembering, for instance, the town in which he was brought up, the different institutions he has been in, and the town in which some of his relatives live, and remembers all these by name. He has no idea of time, but holds a few dates in mind. For example, he said he came to the asylum in 1891, which was correct. He knows the names of most of the months of the year, but has no idea of their order. In January he was asked what month it was and replied that he didn't know. He was then asked if it were June and replied that it was the month before June. When asked what month that was, replied: "That is the month of October." He has had practically no schooling and can neither read nor write. When asked why he didn't go to school when he was a boy he replied that he was too thick-headed to learn. He repeated this on several occasions.

The following questions were asked him: If you had two apples and I gave you two more how many would you have then? How many are five times five? If you worked for me five days and I gave you a dollar for every day you worked, how many dollars would you have, To all these and to other questions he gave the same answer: "Don't know." Questions in regard to his name, the names of otherst his age, and other simple questions he answers intelligently or

with his indifferent "Don't know." In this regard he may be compared to a young child. There is this difference, however: he does not show the curiosity of a child, and displays very little mental initiative. He is like a child, however, in another respect: he is very fond of toys, picture books, and especially of neckties. He asks for them repeatedly, but only apparently when he notices them. He enjoyed playing with my watch and with my ring and asked for the latter several times. When told he could not have a thing or promised it later he always replied "Thank you." He is unable to tell time by the clock or watch, but almost always knows the hour of the day, which he is no doubt able to determine from the regularity of the institution life. In reply to a question he said that he is twenty-one years old and that he had been that age for a long time.

In regard to his chess playing I should say at the outset that he is not a strong player, and that an average player of a year's experience could probably play as well or better. It should be remembered, however, that he has never studied the game at all, has never played regularly, and has not played with many different players. There was no way of determining how long he had known the game, except from his own statements and these are, of course, not very certain. He said he learned about three years ago, that no one had taught him the moves, but that he learned them by watching others play. He has played checkers for many years, but there is no trace in his game at present of interference of association from this source. As is to be expected from the circumstances under which he learned, and played, his play shows very little variety, although there was some improvement in this regard as well as in general chess ability during the time I had him under observation. He has considerable familiarity with certain situations and can be relied on to meet them in certain ways. He usually meets a threat, for example, at once and by dislodging the threatening piece if possible. An analysis of his games shows a number of oft recurring moves such as Kt-R₃, Q-B₃, P-Q₃, and advancing a pawn one square to serve as a guard for a piece or a pawn to be advanced at the next move. Attacking a piece with a pawn, and "forking" two pieces are favorite methods of attack with him. He makes his moves very rapidly and apparently with little or no time for consideration, but usually waits very patiently for his opponent to reply. If the effect of a move of his opponent is not very remote, he notes it almost immediately. For instance, on one occasion when a bishop attacked both of his rooks he announced at once that one of them was lost, and on another occasion when his queen was attacked by a knight, he announced at once that she was lost, a fact which his opponent had not yet appreciated. It may be, of course, that he had anticipated the dangerous move.

He had a great deal of difficulty with a set of chessmen of a pattern different from those he had been using. In the new set the king was larger than the queen, while in the old set the reverse was the case. He was utterly unable to use them until, at his request, a piece of colored cloth, which had been tied around the old queen, was fastened to the new one. After that he had little difficulty with the new set.

At times he seemed to see a situation very quickly, but to be unable to retain it in mind when he attempted to meet it. For instance, when trying to get out of check, he moved his king back into check several times, that is, he would find a move impossible, recall it and then a little later attempt it again.

On the whole it is not too much to say that his game compares quite favorably with those of players whose advantages in the way of in-

struction, study, and practice have been much greater than his, and there is no reason to doubt that with more practice and instruction he would be able to improve his game considerably.

Our conclusions from the study of this case must be, it seems to me, that chess skill is not an index of general intelligence, that the reasoning involved in chess playing is reasoning within very narrow limits, and that a considerable degree of chess skill is possible to one who is mentally deficient in almost every other line.

The following records of games played by this player will indicate to those who are familiar with the game something of his chess ability. The games are chosen as fairly representative of his play during the time he was studied, which extended a little over two months, with an interruption of three weeks between the last observation and the one just preceding it.

Game No. 2.

| White (feeble-minded player) | Black. | White | Black (Feeble minded player) |
|------------------------------|-----------------------|---------------------|------------------------------|
| 1 P-Q4 | P-Q4 | 1 P-K4 | P-K 4 |
| 2 P-K3 | Kt-QB3 | 2 Kt-KB3 | Q-KB3 |
| 3 Q-KB3 | P-K4 | 3 P-O3 | Kt-KR3 |
| 4 P-QB3 | Kt-B3 | 4 B-Kt5 | Q-QB3 |
| 5 Kt-KR3 | QB-Kt5 | 5 KtxKP | Q-K3 |
| 6 Q-Kt3 | Q-K2 | 6 B-KB4 | P-KB3 |
| 7 P-KB3 | B-R4 | 7 BxKKt | PxB |
| 8 QPxP | KtxP | 8 Kt-QB4 | Q-QB3 |
| 9 P-KB4 | Kt-QB3 | 9 KB-K2 | P-QKt4 |
| 10 QKt-R3 | KKt-K5 | 10 B-KR5 (ch) | K-Qsq. |
| 11 Q-B3 | BxQ | 11 P-Q4 | QxKt |
| 12 KtPxP | Q-R5ch | 12 Kt-QR3 | Q-B3 |
| 13 K-K2 | Kt-KB3 | 13 P-Q5 | Q-Kt3 |
| 14 KKt-Kt5 | KB-B4 | 14 O-O | B-QB4 |
| 15 Kt-QKt5 | O-O | 15 Q-K2 | B-QR3 |
| 16 P-QR3 | P-KR3 | 16 P-K5 | P-QKt5 |
| 17 P-Kt4 | B-QKt3 | 17 KPxP | BxQ |
| 18 KtxKBP | RxKt | 18 R-Ksq. | QxP |
| 19 P-QR4 | P-QR4 | 19 RxB | QxQKtP |
| 20 PxP | BxP | 20 R-Ksq. | QxKt |
| 21 K-Qsq. | R-K2 | 21 R-K8 (ch) | RxR |
| 22 B-Q2 | B-Kt3 | 22 RxR (check-mate) | |
| 23 B-Ksq. | Q-R4 | | |
| 24 KR-Kt | QxBp (ch) | | |
| 25 K-Q2 | QxP (ch) | | |
| 26 K-Kt2 | QxR | | |
| 27 Kt-Q3 | QKtxKt | | |
| 28 PxKt | BxQP | | |
| 29 R-Qr | QxKB | | |
| 30 B-Kt4 | Q-QB5 (ch) | | |
| 31 K-Ktsq. | Q-Kt6 (ch) | | |
| 32 K-B | 32 Q-Kt7 (check-mate) | | |